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An Introduction to the Canadian Database on Marked Pacific Salmonids

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ABSTRACT

Kuhn, B.R., L. Lapi, and J.M. Hamer. 1988. An introduction to the Canadian database on marked Pacific salmonids. Can. Tech. Rep. Fish. Aquat. Sci. 1649: viii + 56 p.

This manual documents and describes the development of the on-line Mark Recovery Program (MRP) database and the available data fields. A detailed discussion of the types of data available and their sources and uses in the database is provided, as well as a short discourse on each of the following: data entry and verification activities, database maintenance procedures, related databases, future additions, and possible uses of the database.

The database is designed to provide a well structured, but flexible, data source for salmon stock assessment studies, such as those concerned with contribution rates, survival rates, and distribution patterns. Assessments are possible for individual Canadian or U.S. stocks, and, more generally, for arbitrary stock combinations. The database includes detailed release records for enhanced and wild salmon stocks marked with fin clips, binary-coded wire tags (CWTs), and other types of tags. Also, tag recovery records (usually from individual fish) are available from coastal and fresh water fisheries and in-river areas.

RÉSUMÉ

Kuhn, B.R., L. Lapi, and J.M. Hamer. 1988. An introduction to the Canadian database on marked Pacific salmonids. Can. Tech. Rep. Fish. Aquat. Sci. 1649: viii + 56 p.

Le présent manuel décrit l'élaboration de la base de données interactive du Programme de reprise des poissons étiquetés (RPE) et les champs de données disponibles. Les auteurs discutent en détail des types de données disponibles ainsi que de leurs sources et de leurs utilisations dans la base de données; de même, ils traitent brièvement de chacun des sujets suivants: l'introduction et la vérification des données, les procédures de mise à jour de la base de données, les bases de données connexes, les futurs ajouts ainsi que les utilisations possibles de la base de données.

La base est conçue pour fournir une source de données bien structurée mais souple aux fins d'études sur l'évaluation des stocks de saumon, comme celles se rapportant aux taux de contribution, aux taux de survie et aux modes de répartition. Il est possible de faire des évaluations pour certains stocks canadiens et américains, et, de façon plus générale, pour des combinaisons arbitraires de stocks. La base de données renferme des données détaillées sur la remise à l'eau de stocks de saumon sauvage et d'élevage (mis en valeur) marqués par rognage des nageoires, à l'aide d'étiquettes métalliques codées (EMC) binaires et d'autres sortes d'étiquettes. Egalement, les données de récupération d'étiquettes (provenant généralement de certains spécimens de poisson) sont disponibles pour les pêches côtières et en eaux douces ainsi que des secteurs de cours d'eau.

FOREWORD

This report has evolved from substantial effort by the Canadian Department of Fisheries and Oceans to compile extensive information on marked salmonids, released and recovered on the North American Pacific coast. Appendix D and the Acknowledgments provide a hint of the magnitude and scope of this project. Because the data come from numerous agencies over a period of many years, it is a major task to compile all the information in standard and reliable formats. The authors Louis Lapi and Marc Hamer originally designed and developed the database system reviewed here. A viable system would never have been achieved without their persistent and meticulous attention to detail.

The first author, Brian Kuhn, first became involved as an analyst/programmer in developing flexible user access and reporting software (Kuhn 1988). Later, he was charged with producing introductory documentation for the whole database. This report is the product of his efforts, along with substantial comments from numerous staff members. In a project of this kind, no one person can be an expert on all aspects of the database. Consequently, Brian circulated frequent drafts among concerned staff. The result here thus represents the Department's collective knowledge about the database. Much of the information here has never been published before, and such a complete perspective has certainly never before been available under a single cover.

We believe that this report, and the developments that underlie it, represent a major Departmental achievement. Without such work, it would be impossible for us to take advantage of our (very costly) information or to function in a unified way. We hope that this is only the beginning of similar developments in other areas where critical decisions depend on data compiled collectively. A properly worked example, such as this one, can be a valuable prototype.

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INTRODUCTION

The application of marks to salmonids has been used for many years to evaluate various aspects of the salmon fishery. Specifically, researchers mark groups of salmonids to track migration routes, evaluate contributions to fisheries, and estimate harvest rates. Fin clip external marking experiments have been used in hatchery evaluation programs as early as the 1960's (Lander and Henry 1973; Godfrey 1971). Although fin clips are still in limited use (particularly with pink and chum salmon) as an external mark, the small number of unique possible combinations forced researchers to develop a new marking technique.

The coded-wire tag (CWT) (Jefferts et al. 1963) is currently the most widely used marking method for assessment work. A CWT is a stainless steel segment (.5 to 1 mm in length) cut from a spool of wire. Etched on the surface of each CWT is a binary code which is associated with an electronic record of information consisting of numerous data items.

Juvenile salmon are anaesthetized and then tagged by inserting a CWT into the nose cartilage of each fish. The adipose fin is removed to visually indicate that the salmon contains a CWT. Since some fish may lose their tag, the fish are held for a period of time (a few days or up to a year) after which a sample is taken, and individuals are examined for shed tags. Using this information, a quantity "adipose clip only" is estimated (it is required to determine the actual number released with tags) for the whole group and the fish are released into a stream.

Recovery of CWTs occurs by sampling (1) the commercial troll and net catches, (2) the heads turned in voluntarily by sport fishermen, and (3) the adults returning to enhancement facilities and streams. CWT marked fish are easily identified by a missing adipose fin. From the heads that arrive at the decoding laboratory, detected CWTs are extracted and read. The code, as well as other pertinent data, is recorded.

In 1970, the United States (in particular, Washington State) and Canada entered into a joint study to evaluate the production and contribution of Washington hatchery chinook using CWT technology (J.E. Sager & Assoc. 1985). At this time Canadian hatchery marking for chinook and coho was also included in the study. Canadian sampling for marks began in the Georgia Strait chinook commercial troll fisheries and recreational fisheries in 1973 (Lehmann 1985). By 1974, all B.C. commercial fisheries were being sampled, along with heads submitted by recreational fishermen (J.E. Sager & Assoc. 1985).

Three Canadian government agencies (two federal, one provincial) and 52 American government and native agencies release and recover marked salmonids. Annually, these agencies release millions and recover tens of thousands of salmonids as reflected in the table below (rough estimates):

	Number of unique tags	Released associated with a CWT (billions)	Number of CWTs released (millions)	Released unassociated* (billions)	Number of recoveries (millions)
Canada	4348	2.4	105.5	1.9	0.8
U.S.A.	9843	2.1	239.2	7	1.2

* Unassociated includes: Fin clips and enhanced groups released without any tags.

Information about tagged fish constitute recovery data, i.e., tags are recovered from heads of marked fish. A particular recovery stratum is defined by the location and time a fish is recovered and the species recovered. There are thousands of unique recovery strata used coast wide each year. Recovery data are stratified differently in area and time for each of three types of fisheries. First, commercial fisheries are sampled weekly and the catch is usually available by catch region (a group of geographically defined (statistical) areas and a catch method (gear)). Second, sport recoveries are turned in voluntarily, and fishermen cannot always recall the exact day or week the fish were caught. Consequently, sport data are available by month and statistical area (the area fished is usually known). Finally, escapement recoveries are sampled seasonally by river or stream.

Internally each agency may have its own data record formats and coding scheme, however, a consistent format is required to exchange data between agencies. Historically, the exchange process has not always proceeded flawlessly; consequently, rigorous checking/testing procedures have been applied to most historic data.

The Mark Recovery Program involves three distinct processes of releasing, sampling, and recovering fish. Consequently, the database includes three corresponding data-sets which we reference by the names Release (REL), Sample (SAM), and Recovery (REC), respectively. A release record represents a group of fish associated with a particular CWT, and a sample record represents a group of fish from a particular recovery stratum. By contrast, a typical recovery record has information from an individual fish in a sample. The only exception to this principle occurs in escapement, where bulk recoveries (described in section 2.2.3) are recorded.

Data may be extracted from the MRP database for use in many different applications. For example, a hatchery manager may be interested in stock performance from a particular hatchery. By contrast, a fishery manager may want information about stocks from enhancement facilities that contribute to a particular fishery. A research scientist might use the data to track specific stocks through migration routes. Biologists may wish to test different diets with a particular stock and monitor stock performance in relation to diet. The MRP database has the capability to address such issues.

Chapter 1 - GENERAL OVERVIEW

This report is an introduction to the Mark Recovery Program and its associated database. For the readers convenience, Table 1.1 (p. 5) lists a point-by-point summary of the contents of each chapter and Appendix. Readers will gain an understanding of the complexity of the MRP database and the interrelation of various data types. In chapter two, MRP concepts and processes are thoroughly introduced, as well as a detailed description of the data-sets available. A data record of recovery information represents (in most cases) data for a single observed tag code (observed recovery). As is explained in chapter two, an observed recovery may be expanded to account for sampling levels and untagged ratios. Definitions and explanations of these data expansion methods are also covered in chapter two.

Chapter three begins with a brief discussion of the data entry and verification process. Also, some potential data problems (e.g., contradictions between data sources) are described, along with possible solutions. Finally, the text lists some procedures employed by MRP support staff to maintain, update, and add data to the database.

Two external databases, commercial sales slip and sport catch, contribute data to the MRP database. These are briefly examined in chapter four. Chapter five lays out a plan for incorporating future data-sets into the MRP database. Finally, chapter six lists several examples of potential uses of MRP data.

Appendices A and B give detailed data field descriptions, along with associated value tables. Appendix C describes in detail the binary coding method employed by CWTs. Appendix D provides a historic perspective for the MRP database. This appendix lists the contributions of the Department's staff to the database development effort. Additional recognition of these staff members, is provided in the Acknowledgements.

Throughout this report, we refer to personal communications ("pers. comm.") with individuals who have contributed various details for this document. We have included these names, along with other staff, in the Acknowledgements.

Several related publications are available to provide further details for the following MRP database topics: data entry and management (Holmes 1985), programmer's system documentation for the database access software (Holmes and Hamer 1988), data file descriptions and relations (Holmes and Hamer 1989), user access and reporting software (Kuhn 1988), and data standards and codes for exchange of MRP data (PSC 1988).

Table 1.1 - A point summary of this document

CHAPTER TWO

- Overview of the release and recovery processes involved in the MRP.
- Comprehensive description of the data fields in the database.
- Recovery sampling types and associated data stratifications.
- Calculations necessary for estimating key parameters from the database.

CHAPTER THREE

- Data entry and verification process, data integrity tests, and data problem resolutions.
- Problems that may occur during data sampling or data transportation.
- Maintenance procedures for correcting on-line data and adding new data as they become available.

CHAPTER FOUR

- Brief discussion of two external databases used by the MRP database.

CHAPTER FIVE

- Future developments and data-sets to be included in the database (when available).

CHAPTER SIX

- Examples of questions that may be answered using the database.

APPENDIX A

- Detailed description of all data fields in the database.

APPENDIX B

- List of important data field value tables.

APPENDIX C

- Technical description of the binary-coded wire tag.

APPENDIX D

- Background on the development of the MRP database.

Chapter 2 - DESCRIPTION OF THE DATA

Prior to releasing groups of hatchery reared juvenile salmon, a fraction of the fish are tagged and marked by inserting a CWT in the nose cartilage of each fish and removing its adipose fin. In contrast, wild fish are captured, tagged, and released during their downstream migration. Tagged fish are easily identified, when they are sampled in the commercial catch and the escapement, due to the absent adipose fin. Removal of the adipose fin (in salmon) is reserved for CWT identification (with exception of steelhead and chum fin clip combinations). Alternatively, fish may be marked by clipping one or more fins.

A release stratum includes the following items: tag code or fin clip, species, brood year, release date, hatchery (hatchery reared fish only), release site, and stock. The complete list of fields for a release stratum constitutes a single record in the release database (Table 2.1, p. 7).

The stratum definition for a recovery is more complicated than for a release; it depends on the recovery method (Table 2.7, p. 15). In contrast to the release database, the recovery database contains multiple records for each stratum (except for some escapement samples which have one record for each bulk recovery). Some recovery (Table 2.5, p. 13) and sample (Table 2.6, p. 14) fields pertain only to particular recovery methods. This results from different sampling programs collecting different information for each recovery method.

If every fish in the catch and escapement were examined for an adipose fin clip and every CWT decoded, estimating the total number of recoveries (section 2.4) would be unnecessary since the total number of tagged fish caught would be known. However, as it would be financially unattractive to examine every fish caught in the fishery or recovered in the escapement, the total number of recoveries must be estimated (estimated recoveries).

Other problems with release and recovery practices create further difficulties. For example, hatcheries do not always tag a portion of a release group. Also, marked fish from one pond may be released with fish from other ponds that included no marks. It is difficult to determine which unmarked releases are associated with the marked releases. Different recovery methods have different procedures for sampling catch (or escapement) for CWT marked fish, and these require different formulas for the relevant calculations. Understanding the structure of the database requires careful attention to the definitions of release and recovery strata.

Most data fields in the database comprise raw or observed data. The philosophy used here is provide the basic information for users to undertake their own analyses of the data. In Tables 2.1 (p. 7), 2.5 (p. 13), and 2.6 (p. 14), adjacent to fields that are computed, a "Yes" is present in the column labelled "Computed".

Chapter 2 - A DESCRIPTION OF THE DATA

Table 2.1 - Release fields

Field Name	Format/Maximum size	Computed
01. Tag code (or fin clip code)	12 characters	
02. Species HART code	3 digits	
03. Brood year	2 digits	
04. Run type code	1 digit	
05. Day first released	2 digits	
06. Month first released	2 digits	
07. Year first released	2 digits	
08. Day last released	2 digits	
09. Month last released	2 digits	
10. Year last released	2 digits	
11. Number tagged	8 digits	
12. Adipose clip only	8 digits	
13. Number unclipped (or partial clips)	8 digits	
14. Total released	8 digits	Yes
15. Number of days held	3 digits	
16. Length (mm)	4 digits	
17. Weight (grams/fish)	6 digits; 1 decimal	
18. Percentage tag loss	4 digits; 1 decimal	Yes
19. Expected survival (only fin clips)	5 digits; 1 decimal	
20. Stage code	4 characters	
21. Study type code	1 character	
22. Rearing type code	1 character	
23. Stock type code	1 character	
24. Experiment Identification code	4 characters	
25. Method	1 character	
26. Survival flag	1 character	
27. Program type	3 characters	
28. Highest Replicate number	2 digits	
29. Hatchery site number	4 digits	
30. Release site number	4 digits	
31. Stock site number	4 digits	
32. Agency code	4 digits	
33. Coordinator code	2 digits	
34. Production area code	4 characters	Yes
35. Province/State code	2 characters	Yes
36. Years with recoveries (CWT only)	(10 2-digit fields)	Yes
37. Comment	80 characters	

2.1. Release data

Release data originate from CWT tagged releases and fish released with various fin clip (FC) combinations (non CWT). Table 2.1 lists all the release fields present in a CWT or a FC release record. The text references these fields by number (prefixed by "REL"), e.g., REL05 is the fifth field

(Day first released) in the release record table. Most fields comprise raw data, but there are also five computed fields for which the methods of computation are described below and in Appendix A.

Since not all fish in a release group are tagged, it is necessary to estimate the number of untagged fish. There are several different methods used to estimate the unmarked fraction and the total number of fish in a release group. These methods are described in the next few paragraphs.

- The Peterson estimate is calculated by dipping a net into a holding tank and examining the extracted sample, counting the unmarked (U) and marked (M) fish. This ratio (U/M) is multiplied by the total count of tagged fish to obtain the total number of unmarked fish in the release group. Furthermore adding the total unmarked number to the total number tagged produces an estimate for the total number of fish in the release group.

- Another method for estimating the unmarked fraction is the "book count". The number of eggs that were originally used for the release group is known, and is used as a start count. During the rearing period, eggs, fry, and smolts may die, consequently their number must be subtracted from the start count to calculate the total number of fish remaining in the release group. This estimate is generally an overestimate because predation causes a certain unknown number of fish to "disappear", and the estimate can't account for this.

- Washington State (and occasionally Canadian) rearing facilities use fish weights to determine total release numbers. Fish released into the wild are first weighed to estimate the total biomass as well as the number of fish per pound. The total number of fish released can be calculated by multiplying these estimates. Furthermore, the unmarked portion of the release group is easily found by subtracting the marked number from the estimated total released number.

- Other methods include counting all fish in a release, marking an entire release, or using electronic smolt counters.

Three sites are associated with a release group: the stock of origin, the rearing facility (if not a wild release), and the stream of release. These sites are not necessarily all the same location. For example, brood stock could be taken from Nanaimo River, raised in the Big Qualicum River Hatchery, and released in the Little Qualicum River.

2.1.1. Coded Wire Tag (CWT)

A few days after tagging, a sample is taken from the tagged group to determine the number of tagged fish which have shed their CWT. The tagged fish (in the sample) are passed through a tag detection machine to count the number of fish that have shed their CWT. To obtain the "Adipose clip only" number, the number of fish in the sample that shed their CWT is divided by the total sample and multiplied by the total number of tagged fish.

Chapter 2 - A DESCRIPTION OF THE DATA

The skill of the technician operating the tag insertion machine directly affects the number of tags that will be shed by a tagged release group. When new personnel are employed for tagging, the rate at which CWTs are shed may be high. By contrast, tagging done by skilled staff may have a lower incidence of tag loss (depending on duration of tagging).

Five kinds of CWT tags have been used: standard length CWT's, half length CWT's, X-Ray Readable Binary, Rare-Earth Element codes, and Color codes. Each has advantages and disadvantages.

A binary-coded wire tag is a small piece of wire .5 to 1 mm long that has a 3-, 4-, or 6-bit binary code etched onto the surface. The standard length CWT uses a 6-bit code which provides 3,969 different codes for each agency code. This code uniquely identifies a release group. If a particular tag code is accidentally used for more than one species or brood year, then two characters are appended to the code to identify each generation of the tag code. For example, a first generation code has "*1" appended and a second generation code has "*2" appended and so forth. These latter situations have not regularly occurred since the late 1970's and is strongly discouraged. (See Appendix C for a detailed technical description of the binary-coded wire tag.)

Recently the standard binary tag code design was expanded to allow for embedded replicated releases using the parity check bit (one bit each in Data 1, Agency, and Data 2) as an additional 3-bit binary number for up to eight internal codes. All replicate tags were designated Agency code 42, to be used only for replicate tags. A replicated release allows a researcher to tag a particular release group with different tag codes from the same spool of wire. The significance of this development is currently controversial.

Binary Half Length tags were introduced to allow CWT releases of very small fry (PMFC 1983). These tags are half as long (.5 mm) as their full length counterparts, and use a 3-bit code providing 64 different codes for up to 8 different releasing agencies. Half-tags have been difficult to recover from snouts using the standard systems used for standard CWTs and therefore recovery staff initially used special X-Ray scanning equipment to detect the half-tags. Due to the high cost of the X-Ray technique a new method was devised. The tag is magnetized and a tubular detector is used to detect the half-tags. Half length tags are not used very often by Canadian facilities but are used extensively by Alaskan facilities. Recently, two more data words (DATA 3 and DATA 4) were added to the half length tags to provide more codes per agency code.

X-Ray Readable Binary tag codes have the same length (1 mm) and the same notching for etching the code on to the tag (PMFC 1983) as the standard CWT. These can accommodate up to 16,384 (2^{14}) different codes. The unique feature about X-Ray tags is that they can be decoded in live fish (or removed heads) without extracting the tag but can also be read in the same way standard CWT's are read if desired. The code "XX" appears as the agency microcode (1st 2

digits of the tag code) in the tag code and is shared by multiple agencies. X-Ray Readable Binary tags are not in use any more. In fact, only one tag code of this type has been released.

Rare-Earth Element tag codes use a coating of rare-earth elements, rather than notches, to provide unique coding (PMFC 1983). Decoding a rare-earth tag requires that it be bombarded with high energy X-Rays causing unique X-Ray wavelengths to be emitted that can be read by spectrographic equipment. As with X-Ray tags, these tags can also be read while the tag is still in a live fish. This provides the capability for reading tags from fish that are migrating up river without interfering with their migration. Table 2.2 lists the 11 rare-earth elements used by the National Marine Fisheries Service. This is the only group that uses rare-earth tags.

Table 2.2 - Rare-Earth Element codes (Johnson 1985)

Abbreviation	Element	Abbreviation	Element
Ce	Cerium	Nd	Neodymium
Dy	Dysprosium	Pr	Praseodymium
Er	Erbium	Sm	Samarium
Ga*	Gadolinium	Tb	Terbium
Ho	Holmium	Yb	Ytterbium
Ln**	Lanthanum		

* Gd is the correct abbreviation for Gadolinium. Ga is used to eliminated confusion with color code GD (see Table 2.3, p. 11). Some earlier computer systems could not differentiate between upper and lower case characters.

** La is the correct abbreviation for Lanthanum. Ln is used to eliminated confusion with color code LA (see Table 2.3, p. 11). Some earlier computer systems could not differentiate between upper and lower case characters.

Color-Coded Wire Tags were developed approximately ten years prior to the use of the binary CWT's (PMFC 1983). The physical dimensions of a color tag are very similar to a CWT; instead of a binary etched code, four thin color stripes are painted on the wire surface. Due to various disadvantages such as a limited number of available combinations, fading of colors, and color coating peeling/chipping, the use of the color tag was discontinued by all tagging agencies involved with marine recovery programs. Table 2.3 (p. 11) lists the color codes available for use.

Table 2.3 - Color Codes (Johnson 1985)

Color Code	Numeric Code	Color
BL	72	Blue
BR	73	Brown
CY	93	Chrome Yellow
DB	99	Dark Blue
GD	95	Gold
GM	97	Metallic Grey
GN	75	Green
GY	74	Grey
LA	96	Lavender
LB	76	Light Blue
LG	77	Light Green
MG	94	Medium Green
MX	87	Mixed

[** Note: Numeric codes are not part of the on-line MRP database, they are given here due to historic use. **]

2.1.2. Non CWT

In addition to the CWT technology, combinations of fin clips are used for tagging studies. The three main limiting factors of the fin clips are: a small number of permutations available (compared to CWT's), the potential for fins to regenerate, and the affect on survival rate. Common uses for fin clips include the following: reducing the cost for large tagging studies, small Pink and Chum salmon tagging, and tagging stocks bound for terminal fisheries. (Studies have exhibited some uncertainty on whether fin clips, or an adipose fin clip only, causes lower survival.)

A particular fin clip combination is a form of tag code. There is a finite number of potential clips available as shown in Table 2.4.

Table 2.4 - Fin marks or clips (Johnson 1986)

D	Dorsal
Ad	Adipose
An	Anal
LV	Left Ventral
RV	Right Ventral
LP	Left Pectoral
RP*	Right Pectoral
LM*	Left Maxillary
RM*	Right Maxillary
Cd	Caudal

* A left or right Maxillary bone clip is used with fin clip combinations.

For multiple fin clips, the order used in Table 2.4 must be followed (e.g. D-Ad-Cd, not Ad-D-Cd).

A FC code has basically the same release information recorded and virtually the same record format as the CWT code. Some exceptions include the absence of associated recovery data, Days Held data, and Tag Loss data.

2.2. Sample and Recovery data

There are three basic recovery data types or methods available in the MRP database; these are commercial, sport (recreational), and escapement. Each method has a different sampling program associated with it, and, consequently different data fields. Commercial and escapement observed recovery data records result from CWT marked fish found in samples; whereas, sport observed recovery data are acquired through a voluntary means. Sample data are used in conjunction with recovery data to perform various "estimation" and "expansion" calculations (section 2.4).

Recovery data are only available for CWT type releases; fin clip recovery data are not part of the database. The heads from fish found with missing adipose fins in commercial catch samples, voluntary sport catch, and escapement samples, are sent to the head dissection laboratory where the CWT's are extracted and the code read. The tag code and various other data items are recorded for each individual observed recovery (Table 2.5, p. 13).

Table 2.5 - Recovery fields

Field Name	Format/Maximum size	Computed
01. Tag code	12 characters	
02. Recovery year	2 digits	
03. Replicate number	2 digits	
04. Gear	2 digits	
05. Catch region	3 digits	
06. Brood year	2 digits	Yes
07. Recovery type	1 character	
08. Species HART code	3 digits	
09. Statistical week	3 digits	
10. Statistical area	3 characters	
11. Grade	1 character	Yes
12. Color	1 digit	
13. Length code	1 digit	
14. Length (mm)	4 digits	
15. Weight code	1 digit	
16. Weight (kg)	5 digits with 1 decimal	
17. Sexual maturity	2 digits	
18. Sub-area code	3 digits	
19. Sample location	4 characters	
20. Delivery method	1 character	
21. Scale age	2 digits	
22. Sport location code	7 characters	
23. Recovery site code	1 character	
24. Recovery site number	4 digits	
25. Escapement sample period	2 digits	
26. Sample age type	1 character	
27. Number of observed recoveries	5 digits	

Recovery fields that apply to:

Commercial (Troll)	1-16, 18-21, 27
Commercial (Net)	1-21, 27
Sport	1-10, 22, 27
Escapement	1-8, 23-27

The text refers to the recovery fields by number and the prefix "REC"; e.g., REC05 is the fifth field (Catch region) in the recovery record table. Most recovery fields comprise raw data, however, two fields are computed. Appendix A provides information for the required computations.

Catch and sample data fields, along with several key summary data fields, are also stored in the database (Table 2.6). These fields are referenced by number with the prefix "SAM"; e.g., SAM05 represents the fifth field (Number of lost-pins) in the sample record table. Appendix A describes, in detail, all recovery and sample data fields.

Table 2.6 - Sample fields

Field Name	Format/Maximum size	Computed
01. Catch or escapement	6 digits	
02. Sample size	6 digits	
03. Number of known tags	5 digits	Yes[1]
04. Number of no-pins	5 digits	Yes[1]
05. Number of lost-pins	5 digits	Yes[1]
06. Number with no data	5 digits	Yes[1]
07. Number of sport marks in sample	5 digits	
08. Estimated marks in the est. sport catch	5 digits	Yes
09. Number observed sport recoveries	5 digits	Yes
10. Sum of escapement non-tags	5 digits	Yes[1]

Sample fields that apply to:

Commercial (Troll/Net)	1-6
Sport	1-9
Escapement	1-4, 6, 10

[1]Computed by counting the appropriate records in the recovery file. See Appendix A for more details.

A definition of a recovery stratum is required to grasp fully the magnitude of the recovery data that need to be processed in some of the ensuing calculations. This definition is provided in Table 2.7.

Table 2.7 - Definition of a recovery stratum (SSIU 1986b)

Recovery method	Fields defining a stratum (from Table 2.5, p. 13)
Commercial fishery	02. Recovery year 05. Catch region 08. Species 09. Statistical week
Marine Sport fishery	02. Recovery year 05. Catch region 08. Species 09. Month
Escapement	02. Recovery year 05. Catch region 08. Species 23. Recovery site code 24. Recovery site number 25. Escapement sample period 26. Sample age type

[** Note: Fresh water sport recoveries are currently recorded as catch region 29 and are treated as marine sport recoveries. **]

A set of codes (known as non-tag codes) were developed to resolve problems where no tags were found or could not be read or processed, i.e. an unresolvable dissection. For example, a recovered (sampled) fish identified by a missing adipose fin, or a voluntary sport recovery (only the head is turned in), does not contain a CWT. Alternatively, a CWT is located but is lost or is not readable. Several non-tag (unresolvable dissection) codes are used to indicate different problems. All of these codes have a common format; a two character non-tag type code followed by the three digit species Hart (Hart 1973) code (Hart code "000" is used if the species is unknown). A list of non-tag codes is given in Table 2.8 (p. 16).

Table 2.8 - List of unresolvable dissection (non-tag) codes

Code	Description
NP-nnn	Constitutes a "no pin" recovery, i.e. an attempt was made to locate the CWT, but no CWT was found.
LP-nnn	Represents a "lost pin" recovery. This code is used when a CWT is extracted, but lost before it could be decoded.
ND-nnn	Indicates a "no data" recovery. "No data" recoveries include recoveries where (1) no effort is made to extract a CWT, (2) an unresolvable conflict has arisen such as an observed species which differs from the species code associated with the CWT, (3) the head is not provided (i.e. lost) so the tag can not be extracted, or (4) the tag can not be deciphered.
INFREQUENTLY USED CODES	
CO-nnn	Represents an unreadable color code (see section 2.1.1).
RE-nnn	Indicates an unread rare-earth tag code (see section 2.1.1), i.e. unread by a Canadian agency.
BI-nnn	Represents an unreadable binary code.

[** Note: In each code the characters "nnn" appear, which, for actual codes, is the three digit Hart code. The Hart code is the page number in Hart (1973) for the particular fish species of interest. **]

2.2.1. Commercial

The Department of Fisheries and Oceans contracts out the sampling program for recovery of CWT marked salmonids for commercial troll and net fisheries. Samplers are stationed at various landing sites coastwide to randomly sample, the catch for marked fish. The target sample size is 20% of the weekly catch. This is achieved by sampling all fish from 20% of either vessels, trucks, or packers. Vessels are sampled 90% of the time, trucks are sampled 9½% of the time, and packers are sampled ½% of the time (M. Holmes, pers. comm.[2]).

Various data items are recorded as fish are sampled, including the following: week landed and sampled, sample size, gear type, grade, sexual maturity, length, weight, number of marks, and multiple fin clips (also, scales are removed for aging). The head is removed from each adipose marked fish, an identification tag is attached, and the head is sent to a decoding laboratory where the CWT is extracted and read.

[2]Personal communication sources are listed in a table in the Acknowledgements.

One of the problems with commercial sampling is statistical area and "Catch Region" resolution. In many cases a vessel may fish across several different statistical areas before landing its catch; this does not allow samplers to allocate the sample to a specific area. The statistical areas fished are combined to create an artificial statistical area code. To resolve the multiple area problem and to allocate enough observed recoveries to an area, for statistical reliability, a new area called "Catch Region" was created. A catch region is a combination of several statistical areas and a catch gear. For example, the GSTR (Georgia Strait Troll) catch region encompasses 11 statistical areas and two troll gear types.

There is also a problem with allocating catch to a particular catch region if a vessel has fished more than one catch region. In this latter case, the available catch regions accommodate the multiple catch region predicament with "combined" catch regions. For combined catch regions, only a sample size is known; the catch can not be distributed between the individual catch regions that define the combined region. Consequently, *estimated recoveries can not be calculated for combined catch regions* without further information or additional assumptions.

Observed commercial recovery data are available for recovery year and statistical week, and are statistically reliable for catch regions. Statistical area and sub-area are also recorded when they are known. Various biological data items are recorded, such as length, weight, grade, flesh color (chinook only), and sexual maturity. Each recovery record represents a single observed CWT recovery. For this reason, REC27 (observed recoveries, Table 2.5, p. 13) contains a 1 for all commercial recovery records, whereas, SAM03 (Number known tags, Table 2.6, p. 14) represents the number of observed recoveries for the stratum. In addition to records of known observed CWTs, records are kept of the numbers of missing CWTs (SAM04, "no-pins"), lost CWTs (SAM05, "lost-pins"), and dissection problems (SAM06, "no datas"). These data are the result of the commercial sampling program; i.e., as sampling occurs, the heads of marked salmon are removed and sent to the dissection laboratory, whereby, observed recoveries are recorded and later entered into the database. Furthermore, fields SAM03 through SAM06 are computed by counting, for a particular stratum, the appropriate observed recoveries in the recovery file.

2.2.2. Sport

Acquiring catch and sample information from the sport fishery is more complicated than from the commercial fishery. The catch field (SAM01) within a stratum is estimated by the use of airplane surveys (to estimate effort) and ramp interviews (to estimate catch per unit effort). Sampling (a ramp interview) does not occur coastwide as there are too many locations for a sport vessel to land. Sampling is undertaken; however, for the Strait of Georgia (statistical areas 13 through 20), 12 months of the year. Incidentally, the Georgia Strait fishery was selected as it represents the majority of the B.C. recreational caught fish.

In the Georgia Strait, a recreational fishery survey (creel survey) was designed to collect sport sample data (L. Collicutt, pers. comm.). This program involves interviewing sport fishermen as they land their boats at marinas and ramps. The interviewers collect information on the hour of arrival, trip length, number of people in the party, time spent fishing, and catches kept and released. Additionally, scales are taken from chinook salmon found in the catch. Interviewers also inspect the kept catch (SAM02, "sample") to determine the number of marked coho and chinook (SAM07, "marks in sample"). These numbers allow us to estimate the number of marks in the catch as follows (SSIU 1986b):

$$\text{"marks in sample (SAM07)"} \cdot \frac{\text{"catch (SAM01)"}}{\text{"sample size (SAM02)"}} .$$

This defines field SAM08, a computed field, whose value is retained in the database for convenience.

The incidence of marks in the sample (SAM07) is used with the number of observed recoveries voluntarily submitted by sport fishermen (SAM03 + SAM05 + SAM06[3]) to calculate a sport fisherman awareness factor. An important item to note is that during a ramp or marina interview, heads from marked salmon <u>are not</u> taken by interviewers, since recoveries of this nature would result from a non-random sample. To emulate randomness for the sampling, sport fishermen are requested (via media advertising) to voluntarily submit heads of marked salmon to head depots situated coastwide. Approximately 234 depots (i.e. marinas, tackle shops, hotels) situated throughout the B.C. coast accept CWT tagged fish heads from sport fishermen. A contractor routinely collects up to 12,000 heads from these locations and delivers them to the dissection laboratory.

Sport recovery data are statistically reliable for recovery year and calendar month, and are available by geographical regions such as catch region, statistical area, and sport location. This assumes that the sport fishermen accurately report this information. Currently no biological information is entered into the database for sport recoveries since only fish heads are collected. As with commercial recoveries, each recovery record represents a single observed CWT recovery.

The source of a sport recovery is quite different from a commercial recovery, since sport fishermen voluntarily turn in fish heads from fish missing their adipose fin (SAM09). As in the commercial fishery, these lead to known tags (SAM03), missing pins (SAM04), lost pins (SAM05), or dissection problems (SAM06, "no datas"). Following from this, SAM09 is the sum of fields SAM03, SAM05, and SAM06.

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[3]Some fraction of the "no data" recoveries is included. See section 2.4.2.2 for more details.

The Department has set up an incentive program to encourage anglers to participate in the voluntary recovery program. When a fisherman turns in a head from a marked salmon, the fisherman's name is entered into one of six cash prize draws. The winner's names are published in the Department's sport fishing newsletter, and information on the origin(s) of the marked fish along with a copy of the newsletter and a Sport Head Recovery pin are provided to all participants, including winners.

2.2.3. Escapement

Salmonids generally return to their river of origin to spawn. This process is termed "salmon escapement". These salmonids escape the commercial, sport, and native food fishery catches, returning to their home river.

CWT escapement sampling includes recording the number of heads checked for tags, the number of tags of each tag code found, the site of recovery, the area of recovery, the age type (Adult, Jack, Immature, Mature), and the time of year. Both individual and bulk CWT sampling are performed. An individual sample yields biological data, such as length and weight for each observed recovery. By contrast, bulk samples only account for the total number of observed recoveries for each tag code in the recovery stratum. The database contains both types of samples but currently the biological information associated with individual samples is not entered.

Bulk and individual (without biological data) escapement recovery records are stored in the MRP database. Each record (REC27, Table 2.5, p. 13) represents at least one observed recovery. Stratification of escapement recoveries is by recovery year, sample period, escapement site, escapement site type, and sample age type. There is currently no capture method (gear) information recorded with these data, but this will be available in future updates to the database. Given this limitation there are currently two types of escapement recoveries, random and select. Random recoveries encompass fence and rack recoveries, whereas, select recoveries include dead pitch, beach seining, and angling gears. Actually, escapement counts are incidental to brood stock collection (except for dead pitch); so, escapement recovery methods should be called brood stock collection methods. Table 2.9 (p. 20) lists these methods.

SAM01 gives the estimated total run for the stratum, and as with the commercial and sport fisheries, SAM02 stores the sample size for fish examined for marks. Again, SAM03 records the number of successfully decoded tags, while the remaining heads are represented by no-pins (SAM04) and other non-tags (SAM10, includes lost-pins and no datas). Sample information is sometimes forwarded to head dissection laboratories without the accompanying heads. These undecoded samples are recorded as "no data" recoveries and receive the code "ND-nnn" (Table 2.8, p. 16).

Table 2.9 - Escapement recovery methods (gears)

Fence: (Random sampling)
All fish that pass through the fence are counted and checked for adipose fin clips. A fence is usually constructed a short distance below a hatchery facility.

Rack: (Random sampling)
Rack recoveries are fish recovered at the hatchery, i.e. on the hatchery rack. A fence may limit upstream passage so that fish are guided into a fishway and thus into a hatchery where they are counted at the rack. Some facilities have a fishway but no fence. Fish swim into the fishway for rack counts because the fishway attracts them. (Information on Rack recoveries was provided by C. Cross, pers. comm.).

Active Brood-Stock capture: (Selective sampling)
Where there is no fence or fishway for salmon to return to a hatchery, the staff capture brood stock by using angling (seine), gill, or tangle nets in the stream.

Dead Pitch: (Selective sampling)
This method is used to count dead spawned out salmon that did not move through a fence or rack, i.e., they spawned below the hatchery. They may go above the fence during cleaning or flooding. Dead pitch also may be used to count fish on nearby tributaries or to check for straying fish. (Information on Dead Pitch recoveries was provided by C. Cross, pers. comm.).

2.3. MRP sites

There are four categories of MRP sites: stock, hatchery, release, and recovery. The simplest way to describe the differences between these sites is to provide an example that utilizes each of them. Brood stock can be taken from river A, raised in a hatchery on river B, and released in river C. When the adults return to spawn they could return to river C. In this example, river A is the stock site, river B is the hatchery site, and river C is the release and recovery site. For wild tagging experiments, the hatchery site would be missing, as wild fish are not reared artificially. Generally, all tagged releases will have a stock site and a release site. An escapement recovery can occur at a hatchery or river recovery site as indicated by field REC23 (Table 2.5, p. 13) or it may be just a recovery site.

MRP sites have both a numeric code (up to four digits) and a name (up to 20 characters) for identification. All four types of sites employ the same set of codes and names.

2.4. Calculations and Adjustments

There are three basic quantities that most users calculate using MRP data. These are "observed", "estimated", and "expanded" recoveries. An observed recovery occurs when a tag is decoded for a fish recovered in a particular recovery stratum. Due to the fact that only a fraction of the fish recovered (catch or escapement) is sampled for marks, an expansion factor must be applied to each observed recovery to account for sampling rates; this new quantity is called an estimated recovery. Usually only a fraction of a release group is tagged, therefore an estimated recovery must be expanded as well, in this case, by the total number released (REL14) divided by the total number tagged (REL11) to obtain an expanded recovery. Put more simply, an observed recovery represents a single decoded tag (i.e., 1), an estimated recovery expands this number representing the case where all recovered (catch or escapement) fish were examined for tags, and finally, an expanded recovery expands the number once more as if all releases associated with that tag code were tagged (e.g, one observed recovery may actually represent seven recoveries if all fish were examined).

To account for "non-tag" recoveries, adjustments to the observed recovery count within the stratum can be made. This adjustment may significantly increase the observed count, depending on the recovery method. This section presents the formulas for the three calculations discussed above as well as the adjustment for non-tags.

2.4.1. Adjusted observed recoveries

An adjusted recovery takes into account "lost pin", "no pin", and "no data" recoveries (i.e., non-tag recoveries; see Table 2.8, p. 16). When a non-tag recovery occurs in a given stratum, it can be associated with the real tags in the stratum. For commercial and sport recovery data, the incidence of non-tags is relatively low in comparison to escapement data where they can potentially be quite numerous. Each non-tag could have been a particular known tag code. Following from this, a portion of the non-tags in a particular stratum may be allocated to each known tag recovery in the stratum.

The decision whether to use observed or adjusted observed recoveries is left to the user. For example, the MRP-Reporter program (Kuhn 1988), provides the user with an option to use either number.

An observed recovery, in a particular stratum, can be adjusted using the following calculation:

$$A = O \cdot \left[1 + \frac{LP}{K} + \frac{ND \cdot (K + LP)}{K \cdot (K + LP + NP)} \right] ,$$

where

A - observed recovery, adjusted for non-tags,
O - observed recovery (REC27),
K - number of known (real) tags of all codes recovered (SAM03),
LP - number of "lost pin" recoveries (SAM05),
ND - number of "no data" recoveries (SAM06),
NP - number of "no pin" recoveries (SAM04).

2.4.2. Estimated recoveries

Estimated recoveries are the estimated number of tags (accounts for sampling rates) of a particular code recovered within a stratum. The general formula for this quantity is

$$E = O \cdot \frac{C}{S} ,$$

where

E - the estimated number of recoveries of a particular tag code within a recovery stratum,

O - (i) the observed number of recoveries for the particular tag code within the recovery stratum (REC27) or, as discussed in section 2.4.1, (ii) the adjusted recoveries "A",

C - the catch (or escapement) for the stratum (SAM01),

S - the sample size for the stratum (SAM02).

This formula expands the observed number of recoveries by the ratio of catch to sample, where each recovery method (commercial, sport, and escapement) may define the quantities O, C, and S differently. Consequently, these definitions will be presented separately for each recovery method in the next three sub-sections.

2.4.2.1. Commercial recoveries (Troll and Net)

The formula for estimated recoveries from commercial catch is the simplest of the three recovery methods. It simply multiplies the catch to sample ratio by the observed (or adjusted) recovery count for the stratum as shown here

$$E = O \cdot \frac{C}{S} \quad ,$$

where

E = the estimated number of recoveries of a particular tag code within a recovery stratum,

O = (i) the total number of records for the particular tag code within the recovery stratum (REC27) or, as discussed in section 2.4.1, (ii) the adjusted recoveries "A",

C = the catch for the stratum (SAM01),

S = the sample size for the stratum (SAM02).

2.4.2.2. Sport recoveries

The formula for estimating sport recoveries is quite different from that used for commercial and escapement recoveries. Explicitly, sport recoveries are estimated by the following sequence of calculations:

$$O^* = K + LP + ND \cdot \frac{K + LP}{K + LP + NP} \quad ,$$

$$S' = S \cdot \frac{O^*}{MI} \quad ,$$

$$E = O \cdot \frac{C}{S'} \quad ,$$

where K, LP, and ND are the quantities defined in section 2.4.1, and

MI - the incidence of marked fish in the sample (SAM07),

S - the sample size for the stratum (SAM02),

O - (i) the total number of records for the particular tag code within the recovery stratum (REC27) or, as discussed in section 2.4.1, (ii) the adjusted recoveries "A",

C - the estimated sport catch for the stratum (SAM01),

O^* - an estimate of the number of heads submitted that actually contain CWTs,

S' - the sample size adjusted for the fisherman "awareness factor" (O^*/MI),

E - the estimated number of recoveries of a particular tag code within a recovery stratum.

The quantity O^*, used to calculate the "awareness factor", needs further explanation. It is an estimate of the number of heads submitted that contain tags. These would include K tags extracted and decoded, LP tags extracted but lost (not decoded), and a certain fraction of the ND "no datas". "No datas" occur when no attempt is made to extract a CWT (Table 2.8, p. 16). Since some of these may contain tags, we must include a fraction of them. This fraction is estimated by (K+LP)/(K+LP+NP), that is, the ratio of the number of extracted tags to the number of heads for which an attempt was made to extract tags.

The fisherman awareness factor is required because sport recoveries are acquired through voluntary means. This factor, a number less than 1, reduces the sample size (S) to reflect the awareness of sport fishermen to marked salmon. For example, if 45 marks are observed in a interviewed sample of 900 fish, and fishermen turn in only 15 heads from the stratum, the "awareness factor" would be 0.3 (i.e., 30%). This implies an effective sample size (S') of 300 fish (i.e., 30% of 900), since the remaining 70% of the fish presumably contain marks that are not detected by fishermen. Given the adjusted sample size S', the estimated number E, is computed as usual.

2.4.2.3. Escapement recoveries

Adjusted recoveries (section 2.4.1) are always used to calculate estimated escapement recoveries, because of the potential for a high incidence of non-tags. The formula for estimating escapement recoveries is given here

$$E = A \cdot \frac{C}{S} \quad ,$$

where

E - the estimated number of recoveries of a particular tag code within a recovery stratum,

A - the adjusted observed (REC27, individual or bulk) recovery quantity (a bulk escapement recovery record represents all the observed recoveries for the stratum for the given tag code),

C - the escapement for the stratum (SAM01),

S - the sample size for the stratum (SAM02).

2.4.3. Expanded recoveries

Since releases of juvenile salmon typically include an unmarked (untagged) portion, a calculation must be perform to account for this. Multiplying an estimated recovery by the ratio of the number of fish released to the number with a tag expands an observed tag code to represent the case where all juveniles associated with the tag code are tagged and all salmon in the catch are examined for the tag code.

For all recovery methods, the formula for expanded recoveries is

$$X = E \cdot \frac{R}{T} \quad ,$$

where

X - expanded recoveries; i.e., the estimated number of fish represented by a particular tag code that have been caught within a recovery stratum,

E - the estimated number of recoveries of a particular tag code within a recovery stratum,

R - the number of released fish represented by the tag code (REL14),

T - the number of fish actually containing the tag code at time of release (REL11).

Chapter 3 - DATABASE MANAGEMENT

There are several processes involved in managing any database. A database requires a data entry and verification component and maintenance procedures for updating the database. Additionally, there are usually data collection problems and inconsistencies that must be resolved. A short discussion of each of these topics, for the MRP database, is contained in this chapter.

3.1. Data entry and verification

There are three parts to the data entry process (M. Holmes, 1985) including release record entry, sample record entry, and recovery record entry. A release record must be entered prior to any recovery records associated with the release (the recovery data entry system guarantees this).

Release information is collected by hatcheries and other tagging groups. These data are provided to the Salmon Services[4] group where they are entered into the on-line database. Associated with the release database is a sites file which contains codes, names, and locations of hatcheries, release sites, and stock sites. When a release record is entered, the site codes for the release are verified via the sites table. All coded fields are checked for valid entries, i.e., an invalid species code can not be entered. For the release to be entered, certain mandatory fields must contain a value. Numeric fields are tested for range errors, such as an unusually large release size.

Data entry of sample and recovery data is performed by firms contracted by D.F.O. to carry out the adult recovery program. Recovery information is part of a collected sample. After a sample is taken, the CWTs are extracted and the tag codes determined. This information is recorded on forms that are forwarded from the laboratory to the data entry personnel. When the data are finally entered into the database, it is possible to detect conflicts between the sample information and the tag code release information. For example, if a sample indicates the species to be chinook, but the tag code release data reports the species to be a coho, a conflict arises. This particular conflict may be resolved by re-reading the CWT, by reading the scale, or by checking what the sampler recorded. If after attempting to resolve the conflict, there is no apparent solution, the recovery is entered as a "no data" recovery. All coded field entries are checked against a table of valid codes. Numeric fields are checked for range errors. Related fields are checked for invalid combinations such as length-weight values, i.e. a fish of a certain length will have a weight in a certain range. There are also region verifications such as catch region, statistical area, sub-area combinations. As a result of this extensive error checking, database users are assured of reasonable data integrity.

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[4]Salmon Services, Fisheries Branch, 555 W. Hastings, Vancouver B.C.

3.2. Maintenance procedures

Maintenance is necessary for any well managed database. For the MRP database, there are several tables that are updated as needed. For example: as new hatcheries come on line, new stocks are tagged, or new release sites are utilized, the sites file must be updated. The new sites are assigned a numeric code and a name.

Other maintenance includes building the on-line database from the data files created by the data entry system. This process is executed as needed. The MRP database includes catch information that is received from the Catch Statistics[5] group. These data are included in the database several times during the course of the year as interim data and are usually finalized in the following year.

[5]Catch Statistics, Fisheries Branch, 555 W. Hastings, Vancouver B.C.

Chapter 4 - OTHER RELATED DATABASES

Several sources, other than those described above contribute to the MRP database. This chapter briefly discusses them and shows their importance as a data source for the MRP database.

4.1. Commercial catch

Commercial catch information is recorded on sales slips when a fishing vessel sells its catch. The sales slip records are entered offsite by a contractor but ultimately maintained by the Catch Statistics group. This database includes all sales slip catch for all commercially landed species. For salmon, the data are recorded for individual catch years, weeks, months, statistical areas, catch gears, and species. Catch data are transfered from a magnetic computer tape to the Catch database (Wong, 1983) located on the Pacific Biological Station (PBS) VAX computer in Nanaimo B.C. A pre-processing procedure is initiated to fit these data into the format and organization required by the MRP database.

Catch records are updated several times during the year following the actual catch year. This means that *catch figures from the previous year used early in the current year change several times* before the catch data stabilize. This is an important point, as users of the MRP database could create conflicting analyses if conducted early in the year and re-run much later in the year. Users of the database are not notified when updates to catch data occur, however, update information is available from the Salmon Information Systems[6] group.

4.2. Sport catch

An estimate of the sport catch is provided for the MRP database by the Hook and Line Unit[7] (T. Hoyt, pers. comm.). A contractor provides angler boat counts by flying over north and south Vancouver Island, including Georgia Strait and part of the west coast of the Island. Samplers stationed at various boat ramps, record the number of fish caught, from which an average catch per boat is calculated. This number is multiplied by the boat count for the month to produce an estimate of the sport catch for the month. The sport catch database is managed by the Hook and Line unit as a flat file on the PBS VAX.

Currently these data are available for the Georgia Strait sport catch region (GSPT) from 1980 to the present and the West Coast sport catch region (WSPT) from 1985 to the present (T. Hoyt, pers. comm.). Not all months are surveyed for all years.

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[6]Salmon Information Systems, Biological Sciences Branch, Pacific Biological Station, Nanaimo B.C.

[7]Hook and Line Unit, South Coast Division, Fisheries Branch, Hammond Bay Road, Nanaimo B.C.

Chapter 5 - THE FUTURE OF MRP

The MRP database encompasses many different data types and sources, crossing international boundaries. Given the data's complexity, changes must be anticipated. At the time of writing this document, the database contains virtually all Canadian and American release information, but only Canadian recovery information. American recovery information is not included yet. The complexity and variety of the data-sets required to complete the database are shown by Table 5.1.

Table 5.1 - List of current and potential MRP data-sets (SSIU 1986a)

Code	Description
R1	Hatchery releases associated with tags
R2	Hatchery releases not associated with tags
E1	Estuary studies with smolt releases.
C1a	Commercial tag recoveries
C1b	In river recoveries
C1c	Test fisheries
C1d	Incidental offshore fisheries
C2	Catch and sample data for commercial tag recoveries
S1	Sport catch recoveries
S2	Sport catch "awareness factors"
S3	Sport catch data
I1	Indian food fishery tag recoveries
I2	Indian food fishery catch
H1	Hatchery escapement tag recoveries (individual and bulk)
H2	Hatchery escapements
W1	Wild escapement tag recoveries
W2	Wild escapements
A1	Associated fin clip recoveries

Table 5.1 shows a list of 18 separate data-sets required for a complete database. For each of these data-sets there are six jurisdictions (see Appendix A: Province/State) where these data are collected. Furthermore, there are potentially 17 years (1973-88) of data currently available for each data-set. Completed Canadian data-sets include R1, C1a (1975-present), C2 (1973-present), S1 (1975-present), S2 and S3 (1980-present GSPT, 1985-present WSPT), H1 and H2 bulk recoveries (1973-present), W1 (1974-present).

Alaska, Washington, and Oregon data-sets: C1a-c, C2, S1, S2, and S3, are to be loaded into the database during the next few years. The database is equipped to handle the U.S. data-sets, but the data have not yet been provided by the U.S. agencies. When these data-sets become available for loading into the database, various code translations will be performed to conform to Canadian coding schemes.

Chapter 5 - THE FUTURE OF MRP

Chapter 6 - USES FOR MRP DATA

This chapter discusses some typical uses of MRP data to indicate what kinds of analyses are possible. Since the development of the MRP-Reporter program (Kuhn 1988), consistent access to the data is straightforward. A wide range of users can present a diverse set of requests to the database and receive meaningful results.

- Hatchery managers have an obvious interest in recovery information for tagged releases from their facilities. Recovery data are available by catch region and various divisions of time for each tag code. Survival estimates can be calculated for individual tagged releases or whole stocks.

- Fishery managers can determine the enhancement facilities which are major contributors to a particular fishery. Recovery data can be reported for individual catch regions. Reports can show recoveries from the regions by contributing stocks, hatcheries, or release sites. Hatchery contributions can be estimated for various catch regions.

- Biologists can extract recovery data for size limit studies. It is possible to estimate the number of fish caught in various size ranges by weight or by length. For example, a length distribution of tagged troll caught chinook on the West Coast of Vancouver Is. for the last four catch years can be produced using the MRP-Reporter program (Kuhn 1988).

- Summary tables are easily acquired from the database. These tables can be transferred to microcomputers for further analysis using statistical software or directly loaded into presentation quality graphics software for production graphics (Kuhn et al, 1989).

- MRP data are used extensively in salmon stock assessment analyses. The database is used to examine how well the Department is producing fish at specific hatcheries and how well the varying enhancement techniques perform in terms of survival/success. It has been used in analyses for producing several Pacific Stock Assessment Review Committee (PSARC) papers in 1988.

- Other uses for the database include evaluations of enhancement facility production, migration pattern investigations, mortality rate analyses, and release area (or size) survival studies.

Appendix A - DATA FIELD DESCRIPTIONS

This appendix provides a complete description for each of the 74 data fields in the database that comprise a release record, recovery record, and sample record. Many of the coded fields have an associated description or value "table". Beside the name of each field is a reference to the field's number or position in the associated data record, e.g., "RELnn" refers to a field in a release record where "nn" is the corresponding field number, "RECnn" refers to a field in a recovery record, and likewise, "SAMnn" refers to a field in a sample record.

A.1. Release fields

Tag code (REL01):

- Up to 12 characters defining AG, D1, D2, D3, and D4 where AG is the agency microcode and D1, D2, D3, and D4 are the data codes. Each of these five elements use two characters. The final two characters (when used) indicates a tag code used in multiple releases. For example, if 022192 has been used and another release is made with this tag code, the new tag code would be 022192*2. (D4 is not used for fin clips.)

Species Hart code (REL02):

- 3 digits indicating a page number in Hart's (Hart 1973) book of species. For example, code 115 indicates Coho, which is described on page 115 of Hart's (Hart 1973) book. The list of possible codes is:

108 - Pink	112 - Chum	115 - Coho
118 - Sockeye	124 - Chinook	126 - Masu*
127 - Cutthroat	128 - Steelhead	

* Species code 126 (Masu) is not an actual Hart code. Masu are a Western Pacific species typically found near Japan. There were some transplant experiments to B.C., therefore they are potentially part of the MRP system.

Brood year (REL03):

- 2 digits defining the year in which the brood stock for the release were spawned. For example "86" refers to 1986.

Run type code (REL04):

- 1 digit code for the season in which the majority of broodstock adults leave the marine environment and enter fresh water on the spawning migration. The possible codes are:

1 - Spring (March to May inclusive)
2 - Summer (June to August inclusive)
3 - Fall (September to November inclusive)
4 - Winter (December to February inclusive)
5 - Uncertain extent of timing overlap or a cross
6 - Land-locked

First and Last release dates (REL05-REL10):
- These fields are composed of three sub fields each. A release can occur over a period of a few days or even weeks. The first date refers to the day the release began and the last date is the last day of the release. The sub fields of each date are day, month, and year of release, each two digits.

Number tagged (REL11):
- The number of fish in the release group that were released with CWTs or FCs.

Adipose only (REL12):
- The number of fish in the release group that lost tags during the observation period prior to release (or for FCs, had incomplete fin clips).

Unclipped (REL13):
- The number of fish released without tags or with partial fin clips.

Total released (REL14):
- The number of fish in the release group that were released (tagged or untagged). This field computed as follows:

"Number tagged" (REL11) + "Adipose only" (REL12)
+ "Unclipped" (REL13)

Days held (REL15):
- Up to 3 digits defining the number of days the tagged fish were held before examination for tag loss.

Release length (REL16):
- The units used for length measurements are millimetres. This field is not necessarily present for all releases. Length is stored as an integer (i.e., whole number) data field.

Release weight (REL17):
- The units used for weight measurements are grams per fish. This field is not necessarily present for all releases. Weight is stored as a floating point numeric data field.

Percent tag loss (REL18):
- Represents the percentage of tagged fish which lost tags before release. This number is derived from the Number tagged and Adipose only fields above, as follows:

$$\frac{100 \cdot \text{"Adipose only" (REL12)}}{\text{"Number tagged" (REL11) + "Adipose only" (REL12)}}$$

Appendix A - DATA FIELD DESCRIPTIONS

Expected survival percentage (REL19):

- Represents the expected percentage survival to adulthood of fish in this release. This number is an estimate, based on the size and time at release, as well as the general condition of the fish. Usually, the number comes from a list of proposed bio-standards used in enhancement planning.

Release stage code (REL20):

- 4 character code defining the stage of fish growth at the time of release.

EE	- eyed egg
UF	- unfed fry
UFC	- unfed fry channels
FF	- fed fry
FFS	- fed fry seapen
FFL	- fed fry lake
YE	- yearling
SM	- smolt
SSM	- seapen smolt
UNKN	- Unknown Stage

Study type code (REL21):

- 1 character code defining the type of release.

P - typical hatchery production
E - experimental fish - unusual rearing/release conditions
B - experimental groups which can also be considered production e.g. experimental controls
M - monitoring (key or index streams); "M" indicates an index population used for international stock monitoring.
U - unknown

Rearing type (REL22):

- 1 character code defining the rearing environment of the release group.

H - hatchery; seapen, lakepen, rearing channel.
W - wild unfed
F - wild fed (held short term in pens in river prior to release)
U - unknown

Stock type code (REL23):
- 1 character code defining the stock type of a release. For example, a release group could be taken from the WILD (STOCK TYPE), raised in a HATCHERY (REARING TYPE), and also be a PRODUCTION release (STUDY TYPE).

H - Hatchery
W - Wild
M - Mixed (hatchery and wild)
U - Unknown

Experiment identification code (REL24):
- 4 characters identifying a particular tagging experiment. This code is determined by the tagging co-ordinator.

Method for unmarked count (REL25):
- 1 character defining the method used for calculating (or counting) the unmarked number associated with the release.

B - Book
P - Peterson Estimate
W - By Weight/Volume
C - Physical Count
U - Unknown

Expected survival flag (REL26):
- 1 character code defining indicating an expected survival percentage:

N - Normal range expected
D - Destroyed fish, no survival expected
W - Warning, serious problems, see COMMENTS field

Program type code (REL27):
- 3 character code defining the type of enhancement program responsible for this release.

OPS - Enhancement Operations
SPU - Small Projects Unit
CDP - Community Economic Development Program
PIP - Public Involvement Program
RES - Research
PRV - Province of B.C.

Highest Replicate number (REL28):
- 2 digits defining the number of embedded replicate codes used with this tag code, if applicable.

Appendix A - DATA FIELD DESCRIPTIONS

Hatchery code (REL29):

- A code, up to 4 digits, defining the hatchery in which the release was raised. This code refers to the sites file, which currently contains approximately 2000 entries. In the site file there is a name associated with each hatchery number. This field is left blank for wild releases.

Release site code (REL30):

- A code, up to 4 digits, defining the release site at which the group of fish were released. This code refers to the sites file.

Stock site code (REL31):

- A code, up to 4 digits, defining the site where the brood stock for the release was taken. This code refers to the sites file.

Releasing agency code (REL32):

- 4 character code defining the releasing agency. The agency microcode in the tag code is associated with this field. However, an agency can use more than one microcode for its releases. A table of agency names, codes, and microcodes is provided in Appendix B.

Co-ordinator code (REL33):

- 2 digit code defining the release co-ordinator number. This number references a person coordinating all releases for the releasing agency.

Production area code (REL34):

- 4 character code representing a geographical rollup (group) of hatchery, release, or stock sites. This field is obtained from the sites file.

Releasing province or state code (REL35):

- 2 characters defining the province (or state) of release. This code is obtained from the Sites file (see section 2.3). The list of possible values is:

BC - British Columbia	YU - Yukon Territory
WA - Washington	OR - Oregon
AK - Alaska	ID - Idaho
CA - California	

Years with recoveries (REL36):

- Ten 2 digit sub-fields, each representing a recovery year. If a sub-field is equal to 00, it is unused. As recoveries are entered into the recovery data-set, years where a tag hasn't been recovered, are entered here.

Comment (REL37):

- 80 characters describing any problems, anomalies, or points of interest associated with the release. This field contains an explanation for instances of 'W' in the Expected survival flag field.

A.2. Recovery fields

Currently there are four possible recovery methods: troll, net, sport, and escapement. The letters T, N, S, or E in square brackets indicate which of these four methods apply to each field. The fields are listed according to the number of methods that apply.

Tag code (REC01): [T N S E]
- There is one difference between release and recovery tag codes. At release, the tag code is always known; whereas, on recovery, due to circumstances such as tag loss, the tag code might not be known. Thus, it is necessary to devise codes for unknown tags. See Table 2.8 (p. 16) for a list of possible non-tag (unknown tag) codes.

Recovery year (REC02): [T N S E]
- 2 digits defining the year in which the tag was recovered. For example, "84" represents 1984.

Replicate number (REC03): [T N S E]
- up to 2 digits defining the replicate number for the recovered tag code, if applicable.

Catch region (REC05): [T N S E]
- A 3 digit number or a name consisting of up to 20 characters defining the catch region in which the fish was recovered. The definition of catch region combines several statistical areas with a gear type.

Brood year (REC06): [T N S E]
- 2 digits defining the year in which the brood stock for the release were spawned. For example "86" refers to 1986. This field is obtained from the release data-set.

Recovery type (REC07): [T N S E]

- 1 character code defining the type of recovery. This code indicates both the recovery method and the random (or nonrandom) nature of the recovery. A random recovery is associated with a random sample. A nonrandom recovery corresponds to a marked fish that was selectively recovered. Valid codes are listed below:

blank	Random commercial, 1975-78
0-9	Random commercial, 1979-83
D	Random commercial, 1984-present
L	Random commercial logbook
R	Random escapement
Z	Sport (treated as random)
T	Nonrandom commercial logbook (strap)
H	Nonrandom special commercial logbook
F	Nonrandom commercial freezer logbook
S	Nonrandom SELECT Non Sport

Species Hart code (REC08): [T N S E]

- 3 digits indicating a page number in Hart's (Hart 1973) book of species. For example, code 115 indicates Coho, which is described on page 115 of Hart's (Hart 1973) book. The list of possible codes is:

108 - Pink	112 - Chum	115 - Coho
118 - Sockeye	124 - Chinook	126 - Masu*
127 - Cutthroat	128 - Steelhead	

* Species code 126 (Masu) is not an actual Hart code. Masu are a Western Pacific species typically found near Japan. There were some transplant experiments to B.C., therefore they are potentially part of the MRP system.

Number of observed recoveries (REC27): [T N S E]

- Indicates the number of recoveries associated with this tag code. For troll, net, and sport this number is always equal to 1; whereas, for an escapement recovery, this number may represent the total number of recoveries for the stratum, because most escapement recoveries currently originate from bulk samples.

Gear (REC04): [T N S]

- 2 digit code defining the gear used in catching the fish. The list of possible codes is:

07 - Sport	10 - Gillnet	15 - Mixed net
20 - Seine	30 - Troll general	31 - Troll freezer
32 - Troll day	33 - Troll ice	

Statistical week (REC09): [T N S]

- 3 digits defining MMW, where MM (01 to 12) indicates the calendar month and W (0 to 6) indicates the week within the month. Sport recovery weeks represent calendar weeks, not statistical weeks. If W = 0, the week is not known. For example, for sport recoveries the week is usually not known. W = 6 can only occur for a sport recovery (a rare occurance).

Period (associated with Statistical week): [T N]

- 2 digits defining the commercial sampling period that the recovery occurred in. Period is directly related to Statistical week and ranges from 1 to 40. The relationship of Period to Statistical week is shown in the table below:

Week	Jan 01	Feb 02	Mar 03	Apr 04	May 05	Jun 06	Jul 07	Aug 08	Sep 09	Oct 10	Nov 11	Dec 12
1	40	40	1	5	10	14	18	23	27	31	36	40
2	40	40	2	6	11	15	19	24	28	32	37	40
3	40	40	3	7	12	16	20	25	29	33	38	40
4	40	40	4	8	13	17	21	26	30	34	39	40
5	40	0	0	9	0	0	22	0	0	35	0	0

e.g., given Month (MM) = 5 and Week (W) = 3, Period = 12

Statistical area (REC10): [T N S]

- 3 character code defining the statistical area in which the fish was recovered. This field is frequently missing in historical data. Records from 1984 to the present always include statistical area. New areas are sometimes defined as combinations of old ones. For example, catch from a troller fishing in several statistical areas would be reported in a combined area.

Sub area (REC18): [T N]

- 3 digit code defining a catch sub-area within the statistical area. This field is frequently equal to zero as recoveries can not always be allocated to such precisely defined areas.

Grade (REC11): [T N]

- 1 character code representing the grade category of the fish recovered. It applies only to chinook, and must be interpreted in relation to the gear type used. This field is computed from the gear and weight.

Grade Code	Troll weight range (gears 30,31,32,33)
U(nknown)	N/A
S(mall)	0 lb <= weight < 8 lb
M(edium)	8 lb <= weight < 12 lb
L(arge)	12 lb <= weight

Grade Code	Net weight range (gears 10,15,20)
U(nknown)	0 lb <= weight < 2 lb
S(mall)	2 lb <= weight < 5 lb
M(edium)	5 lb <= weight < 12 lb
L(arge)	12 lb <= weight

Color (REC12): [T N]

- 1 digit code used only for chinook salmon to indicate the flesh colour:

1 - Red 2 - White 3 - Mixed

Length (REC13-14): [T N]

- This field consists of two parts, the length code and the length measurement. A 1 digit length code indicates the length measurement method:

0 - unknown (no length recorded)
1 - fork length
2 - hyperal length
3 - total length

- 4 digits are used to report the length (in millimetres) of the fish recovered.

Weight (REC15-16): [T N]

- This field consists of two parts, the weight code and the weight measurement. A 1 digit weight code indicates the weight measurement method:

0 - unknown (no weight recorded)
1 - round weight
2 - dress weight

- 5 characters (4 digits and a decimal : ddd.d) are used to report the weight (in kilograms) of the fish recovered.

Sample Location (REC19): [T N]
- 4 character code or 2 digit code identifying the commercial sampling location (the table of codes will be available at a future time).

Delivery method (REC20): [T N]
- 1 character code defining how commercial recoveries arrived at a sampling site.

V - Vessel lands fish at sampling site
T - Truck delivers fish from Vessel or Packer to sampling site
P - Packer lands fish at sampling site

Scale age (REC21): [T N E]
- 2 digits defining the age of the fish determined using the scale aging method (currently not available).

Sexual maturity (REC17): [N]
- 2 digit code defining the maturity/sex of the recovered fish:

00 - not examined
01 - immature female
02 - mature female
03 - immature male
04 - mature male
05 - examined, but unknown

Sport location code (REC22): [S]
- 7 character code defining the location where a sport recovery actually occurred. Sport locations have associated latitudes and longitudes. Currently, there are approximately 1,100 unique sport locations.

Escapement recovery site code (REC23): [E]
- 1 character indicating the type of escapement recovery:

H - hatchery recovery
R - non-hatchery recovery

Historically, "R" indicated river recoveries, but now many other types of non-hatchery recoveries are possible.

Escapement recovery site number (REC24): [E]
- 4 digit code defining the recovery site in which the recovery occurred. In the main database, this number is kept in a sites file, which currently contains approximately 2000 entries. In the site file there is a name associated with each escapement site number.

Escapement sample period (REC25): [E]
- 1 digit defining the time of year when the escapement recovery occurred:

0 - Yearly	1 - Spring	2 - Summer
3 - Fall	4 - Winter	

More precisely, "0" means the sample period is not reported; therefore it is considered to be yearly.

Sample age type (REC26): [E]
- 1 character code indicating the age type of the fish. Escapement samples are typically stratified by age type. For example, a sample might be oriented entirely toward jacks (two year olds). In the inevitable cases where the observed age (from the CWT) differs from the sample age type, corrections are made to sample size, etc. The database includes all such adjustments. Possible age types in relation to age are:

Type	Age
A - Adult	>= 3 years
J - Jack	= 2 years
I - Immature	= 1 years
M - Mixed	>= 1 year; i.e., not sampled by age

Age may be calculated as the recovery year minus the brood year.

Recovery province or state: [T N S E]
(future use)

A.3. Sample fields

Catch, escapement, sample, non-tag, and sport awareness factor information is used to calculate estimated recoveries (see section 2.4.2).

Catch or Escapement (SAM01): [T N S E]
- This field contains the total estimated catch (or escapement) associated with the stratum of the recovery.

Sample (SAM02): [T N S E]
- This field contains the total number of fish examined in the stratum for clipped adipose fins; i.e., it contains the sample size associated with the stratum.

Number of known tags (SAM03): [T N S E]
- This field represents the total number of CWTs for all tag codes successfully decoded within the stratum. To compute this field, REC27 is accumulated from known observed tag records in the recovery data-set.

Number of no-pins (SAM04): [T N S E]
- This field represents the total number of no-pin recoveries for the stratum. A no-pin recovery occurs when an attempt is made to locate a CWT, without success. To compute this field, REC27 is accumulated from no-pin records in the recovery data-set.

Number of lost-pins (SAM05): [T N S]
- This field represents the total number of lost-pin recoveries for the stratum. A lost-pin recovery occurs when a CWT is extracted, but either (1) is lost before it is read or (2) is unreadable. More precisely, this field records the number of lost-pins, unreadable color codes, rare-earth tags, and unreadable binary codes. To compute this field, REC27 is accumulated from lost-pin records in the recovery data-set.

Number with no data (SAM06): [T N S]
- This field represents the total number of no-data recoveries for the stratum. A no-data recovery occurs when (1) the fish has an adipose fin clip, but no effort is made to locate a CWT, (2) the head is lost before it reaches the decoding laboratory, (3) an unresovable conflict is discovered, or (4) the tag can not be decoded. To compute this field, REC27 is accumulated from "no data" records in the recovery data-set.

Number of sport marks in sample (SAM07): [S]
- This field represents the number of adipose clipped fish observed in the sample for the stratum. This field, as is the **SAMPLE** field, is associated with ramp interviews.

Estimated marks in the est. sport catch (SAM08): [S]
- This field represents the estimated number of marks in the estimated sport catch for the stratum. This field is be computed as follows:

$$\text{"Sport marks in sample" (SAM07)} \cdot \frac{\text{"Catch" (SAM01)}}{\text{"Sample" (SAM02)}}$$

Number observed sport recoveries (SAM09): [S]
- This field represents the number of heads voluntarily submitted to sport head depots for the stratum (excluding "no-pins"). This field is be computed as follows:

"Known tags" (SAM03) + "Lost-pins" (SAM05) + "No datas" (SAM06)

Sum of **escapement non-tags** (SAM10): [E]
- This field represents the total number of non-tags, excluding no-pins, for this stratum. This field would be the sum of fields "Number of lost-pins" and "Number with no data" above, if these numbers were available. However, for escapement recoveries, non-tags are not separated in these two categories; only the sum is recorded (here). To compute this field, REC27 is accumulated from non-tag records (excluding no-pins) in the recovery data-set.

Appendix A - DATA FIELD DESCRIPTIONS

Appendix B - DATA FIELD TABLES

This appendix provides large tables associated with some of the database fields.

B.1. Releasing agency codes

This table is associated with the "Agency" data field found in release records. The table lists four pieces of information, namely "Microcode", "Code", "Name", and "Country". The column labelled MICROCODE is a list of tag code prefixes that are associated with the Agency code. For example, tag code 023433 has the MICROCODE "02" and is released by the Canadian Dept. of Fisheries & Oceans (CDFO) releasing agency. Certain agencies share microcodes 00, 62, or H0. In the table, these agencies have the MICROCODE column left blank.

MICROCODE	CODE	NAME	COUNTRY
01,13,15,63,H1	WDF	Washington Dept. of Fisheries	USA
02,H2	CDFO	Canadian Dept. of Fisheries & Oceans	CDN
03,23,H3,$$,##	NMFS	National Marine Fisheries Service	USA
04,31,H4,HF	ADFG	Alaska Department of Fish & Game	USA
05,14,H5	FWS	Fish & Wildlife Service	USA
06,H6	CDFG	California Dept. of Fish & Game	USA
07,09,H7	ODFW	Oregon Dept. of Fish & Game	USA
08	CDFR	Can. Dept. of Fisheries & Oceans Research	CDN
10	IDFG	Idaho Dept. of Fish & Game	USA
11	UW	U. of Washington, College of Fisheries	USA
12	BCFW	B.C. Fish & Wildlife	CDN
12	BCEP	B.C. Environment and Parks	CDN
21	NIFC	Northwest Indian Fisheries Commission	USA
21	SSC	Skagit System Cooperative	USA
47	MIC	Metlakatla Indian Community	USA
60,XX,XR	OAF	Oregon Aqua-Foods, Inc.	USA
B0	UAJ	University of Alaska - Juneau	USA

continued. . .

MICROCODE	CODE	NAME	COUNTRY
	ANAD	Anadromous, Inc.	USA
	COOP	Washington Dept. of Fisheries Cooperative	USA
	ELWA	Elwah Indian Tribe	USA
	HOH	Hoh Indian Tribe	USA
	LUMM	Lummi Indian Tribe	USA
	NISQ	Nisqually Indian Tribe	USA
	SQAX	Squaxin Indian Tribe	USA
	STIL	Stillaguamish Indian Tribe	USA
	SUQ	Suquamish Indian Tribe	USA
	TULA	Tulalip Indian Tribe	USA
	YAKI	Yakima Indian Tribe	USA
	DOMS	Domsea Farms, Inc.	USA
	NSRA	Northern SE Regional Aquaculture Assoc.	USA
	QDNR	Quinault Dept. Natural Resources	USA
	OSU	Oregon State University	USA
	SOF	Silverking Oceanic Farms	USA
	SJ	Sheldon Jackson College	USA
	SKAG	Skagit System Cooperative	USA
	WDG	Washington Dept. of Game	USA
	BHSR	Burnt Hill Salmon Ranch	USA
	MUCK	Muckleshoot Indian Tribe	USA
	SSRA	Southern Southeast Reg. Aquaculture Assoc.	USA
	CIAA	Cook Inlet Aquaculture Association	USA
	OPSR	Oregon-Pacific Salmon Ranch	USA
	PPWR	Puget Power	USA
	PUYA	Puyallup Tribe	USA
	DIPC	Douglas Island Pink and Chum (Ak)	USA
	PNPT	Point No Point Treaty Council	USA
	SKOK	Skokomish Indian Tribe	USA
	AKAF	Alaska Aquaculture Foundation Inc.	USA
	UI	University of Idaho	USA
	MAKA	Makah Indian Tribe	USA
00,62,H0	--	Microcodes reserved for multiple agency use.	

B.2. Production area codes

CODE	NAME or DESCRIPTION
BRGT	Brights (Columbia river)
CALI	California
CCST	Central coast - Statistical areas 6 - 8
DESC	Deschutes
GSML	Georgia Strait Mainland - Statistical areas 15, 16, 28, 29
GSVI	Georgia Strait Vancouver Island - Statistical areas 14, 17, 18, 19
HEAD	Head waters (Columbia river)
JNST	Johnstone Strait - Statistical areas 11 - 13
KOOT	Kootenays
LOCO	Lower Columnia river
LWFR	Lower Fraser river - Fraser river & Tributaries below Hope
LWOR	Lower Oregon
LWWA	Lower Washington
NASS	Nass river - Nass river & Tributaries (Statistical area 3)
NCST	North coast - Statistical areas 3 - 5 Except SKNA & NASS
NIAK	Northern inside Alaska
NOAK	Northern outside Alaska
NWVI	Northwest Vancouver Island - Statistical areas 25 - 27
QCI	Queen Charlotte Islands - Statistical area 1, 2
RIVR	Rivers/Smith Inlets - Statistical areas 9 - 10
SACR	Sacramento
SIAK	Southern inside Alaska
SKNA	Skeena river - Skeena river & Tributaries (Statistical area 4)
SNAK	Snake river
SOAK	Southern outside Alaska
SWVI	Southwest Vancouver Island - Statistical areas 20 - 24
THOM	Thompson river - Thompson river & Tributaries
UNKN	Terra Incognita
UPFR	Upper Fraser river - Fraser river & Tributaries above Hope
UPOR	Upper Oregon
UPWA	Upper Washington
WA01	Washington management area 1
WA02	Washington management area 2
WA03	Washington management area 3
WA04	Washington management area 4
WA05	Washington management area 5
WA06	Washington management area 6
WEAK	Western Alaska
WILL	Williamette
YUKN	Yukon

B.3. Catch region codes

CODE	PNEUMONIC	NAME
01	NWTR	NW Vancouver Is. Troll
02	SWTR	SW Vancouver Is. Troll
03	WOT	Washington/Oregon Troll Historical
04	GSTR	Georgia Strait Troll
05	CTR	Central Troll
06	NTR	Northern Troll
07	ATR	Alaska Troll Historical
08	FGN	Fraser River Gill Net
09	NN	Northern Net
10	GSN	Georgia Strait Net
11	JSN	Johnstone Strait Net
12	CN	Central Net
13	JFN	Juan de Fuca Net
14	JFTR	Juan de Fuca Troll
15	NWTR & CTR	NW Vancouver Is. and Central Troll
17	NWTR & SWTR	NW Vancouver Is. and SW Vancouver Is. Troll
18	NTR & CTR	Northern and Central Troll
19	JSN & CN	Johnstone Strait and Central Net
20	NWVN	NW Vancouver Is. Net
21	SWVN	SW Vancouver Is. Net
25	NSPT	Northern Sport
27	WSPT	Washington Sport
28	GSPT	Georgia Strait Sport
29	FWSP	Fresh water Sport
33	NN & CN	Northern and Central Net
34	GSTR & CTR	Georgia Strait and Central Troll
36	YKN	Yukon Net
37	JFN & GSN	Juan de Fuca and Georgia Strait Net
45	JSN & GSN	Johnstone Strait and Georgia Strait Net
46	FGN & GSN	Fraser Gillnet and Georgia Strait Net
47	AN	Alaska Net - Alaskan fish landed/sampled in Canada
48	BC	British Columbia (unknown)
53	GSTR & SWTR	Georgia Strait and SW Vancouver Is. Troll
56	NCTR	North Central Troll
57	SCTR	South Central Troll
58	FSN	Fraser River Seine Net
60	WAN	Washington Net - Wash. fish landed/sampled in Canada
99	CDN ESCMENT	Canadian Escapement

B.4. Catch region - Gear - Statistical area mapping

This table shows the gear combinations and statistical areas that are associated with each catch region aggregate. Blank entries under the heading 'STATISTICAL AREAS' indicate a combined catch region.

Tr = Troll FT = Freezer troll Gn = Gill net Sn = Seine net

CATCH REGION	GEARS	STATISTICAL AREAS
01 (NWTR)	Tr FT	25 26 27
02 (SWTR)	Tr FT	21 23 24
03 (WOT)	Tr FT	C (Washington catch)
04 (GSTR)	Tr FT	13 14 15 16 17 18 29 29A 29B 29C 29E
05 (CTR)	Tr FT	
06 (NTR)	Tr FT	1 2E 2W 3 4 5
07 (ATR)	Tr FT	
14 (JFTR)	Tr FT	20
15 (NWTR & CTR)	Tr FT	
17 (NWTR & SWTR)	Tr FT	
18 (NTR & CTR)	Tr FT	
34 (GSTR & CTR)	Tr FT	
53 (GSTR & SWTR)	Tr FT	
56 (NCTR)	Tr FT	6 7 8 9 30
57 (SCTR)	Tr FT	10 11 12
08 (FGN)	Gn	29 29A 29B 29C 29D 29E
09 (NN)	Gn Sn	1 2E 2W 3 4 5
10 (GSN)	Gn Sn	14 15 16 17 18
11 (JSN)	Gn Sn	12 13
12 (CN)	Gn Sn	6 7 8 9 10 11
13 (JFN)	Gn Sn	20
19 (JSN & CN)	Gn Sn	
20 (NWVN)	Gn Sn	25 26 27
21 (SWVN)	Gn Sn	21 22 23 24
33 (NN & CN)	Gn Sn	
36 (YKN)	Gn	
37 (JFN & GSN)	Gn Sn	
45 (JSN & GSN)	Gn Sn	
46 (FGN & GSN)	Gn Sn	
47 (AN)	Gn Sn	
58 (FSN)	Sn	29A 29B
60 (WAN)	Gn Sn	
25 (NSPT)	Sport	1 3 4 5 2E 2W
26 (CSPT)	Sport	6 7 8 9 10 11 12 30
27 (WSPT)	Sport	21 23 24 25 26 27
28 (GSPT)	Sport	13 14 15 16 17 18 19 20 28 29 29A 29B 29C 29D 29E
29 (FWSP)	Sport	OFW - Freshwater.
48 (BC)(Uknwn)	Gn Sn Tr FT	

Appendix C - TECHNICAL DESCRIPTION OF THE BINARY CWT

Most of this material is taken from PMFC (1983) but is expanded to include current developments, such as the six word binary-coded tag. Binary-coded wire tags are cut from a spool of stainless steel wire previously etched with a repeating and predetermined code. Physically, these tags measure approximately ½mm in diameter and 1mm in length. Spaced uniformly around the outer surface are four (six rows for six word half length tags) lengthwise rows of etched notches which provide coded "words" in the binary system. One of the rows is used as a master word to provide correct orientation for reading the other three (or five) words (DATA 1, AGENCY, and DATA 2) as explained below (for six word half tags the words are MASTER WORD, DATA 1, DATA 2, AGENCY, DATA 3, and DATA 4).

Notches on the wire tag are read as "binary 1" while unnotched positions represent "binary 0". Conversion to decimal values is done by assigning the ascending powers of two to the first six positions from right to left (i.e. 2^5, 2^4, 2^3, 2^2, 2^1, and 2^0; or 32, 16, 8, 4, 2, and 1). Thus a binary word read as 011101 corresponds to decimal 0+16+8+4+0+1 = 29.

Binary tags currently in production use a 6-digit code (i.e. the binary words represented by the notches occupy six spaces). An additional seventh position is used for the error or parity check in each of the data words. Since the tags are cut off every 8½ intervals (notch spaces), at random, at any point in the binary code, the master word will occur in different patterns on the tag.

The master word is recognized in that it contains an extra half-interval notch between the first and second notches:

Check	32	16	8	4	2	1	Column identification
0	0	1	1	1	1	1	MASTER WORD

Once the master word is located, the CWT is oriented horizontally so that the binary code reads from right to left or left to right. The remaining data words are then read by rotating the tag clockwise on its axis, as viewed from the right-hand end, so that the master word moves upward. As the three data words come into view (every 90°), they are DATA 1, AGENCY, and DATA 2 (include DATA 3 and DATA 4 for six word half length tags - every 60°).

The error check bit in the seventh column is used as a check against coding errors in the three data rows (excluding replicate tag codes). The number of notches, including the error check bit, must always be odd in each word. For example, in Figure 1, there are five notches in positions 1-6 of DATA 1. Therefore, the error check position is unnotched since the number of notches is odd. However, for DATA 2, the number of notches in positions 1-6 is even (4), thus requiring the error check to be notched. Notice the CK position is repeated and position 1 is shown one and a half times. This is due to the random cutting of the spool every 8½ spaces.

Appendix C - TECHNICAL DESCRIPTION OF THE BINARY CWT

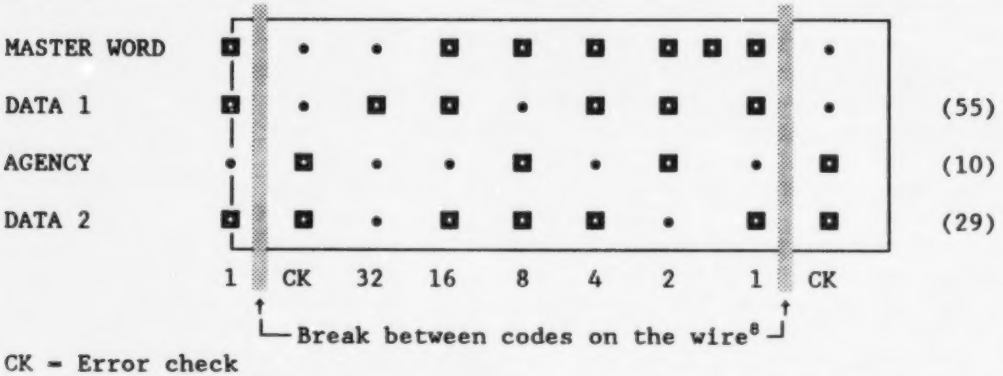

Figure 1 - Diagram of a 6-bit binary-coded wire tag.

The tag code diagrammed in Figure 1 shows what would be seen if a CWT were "unrolled", i.e., the top of the MASTER WORD were disconnected from the bottom of the DATA 2 WORD. Each ■ character indicates a notched space corresponding to binary 1 and each • character indicates an unnotched space corresponding to binary 0. This is an example of the tag code 10-55-29, where AGENCY equals 10 (binary 001010), DATA 1 equals 55 (binary 110111), and DATA 2 equals 29 (binary 011101).

[8]The break is used here for illustrative purposes only, it is not actually visible on the wire.

Appendix D - DEVELOPMENTAL HISTORY

This appendix discusses the move, beginning in 1982, to implement the MRP database on the VAX computer at PBS, in Nanaimo, B.C. This information is included to provide some perspective on why and how the database was designed and implemented and who was involved in this venture.

Prior to 1984, the data entry and processing for MRP was provided by Block Bros. under contract to the Department of Fisheries and Oceans (DFO). Improved reporting capabilities, better response to data requests, cost efficiencies, and better control over data integrity were some of the reasons that prompted DFO to implement the database in-house. A locally managed system would recover approximately $100,000 in annual computing costs (Lapi 1983). This led users of the data to devise a new approach to the MRP database beginning in 1982 by forming the Mark Recovery Program Technical Steering Committee (MRPTSC). Representatives from all MRP user groups were appointed to the MRPTSC:

Fisheries Research	Fisheries Branch	Regional Planning/Econ.
Louis Lapi (Chairman)	Ken Pitre	Margaret Birch
Paul Starr	Vic Palermo	
	Don Bailey	
	Sue Carruthers (Lehmann)	
	Maureen Holmes	
S.E.P.	Computing Services	
Carol Cross	Marc Hamer	
	Val Whitehead	

Several general tasks were identified by the MRPTSC (Lapi 1983):

1. Specification and requisition of a mini-computer system for the database system to occupy.
2. Preparation and implementation of data entry system specifications.
3. Preparation and implementation of database system specifications.
4. Development of checking/editing procedures to "fit" the historic data into the new data formats developed with the data entry system.
5. Preparation and implementation of data access and reporting software.
6. Incorporation of other data-sets such as escapement data and U.S. data.

The following three sub-committees were struck to work on some of the specific problems and needs associated with the development: a Reports Sub-committee, a Standardization of Codes Sub-committee, and a Data entry and Validation Sub-committee. These sub-committees were chaired by M. Birch, L. Lapi, and V. Whitehead respectively.

Appendix D - DEVELOPMENTAL HISTORY

In 1983, M. Hamer of the Computing Services group at PBS was enlisted as an analyst/programmer to design and develop the MRP database. Working closely with L. Lapi and other MRP data users, M. Hamer designed the database and wrote the entry level access software in FORTRAN. Programs that build the database from historical catch, sample, and recovery data records as well as the current years sample and recovery data from the data entry system, were written by M. Hamer. A release data maintenance program used for entering new release data records was also created.

M. Hamer and L. Lapi wrote dozens of data editing programs for identifying and correcting historical sample data, commercial and sport recovery data, and escapement recovery data. Editing programs were also written for checking and loading the Canadian and American release data. The task of preparing historical Canadian recovery data for loading into the database proved to be quite burdensome. Certain year groups maintained consistent coding schemes while others arbitrarily differed. These historic inconsistencies made it difficult to "fit" previous years recovery data into the new database format and coding scheme.

V. Whitehead designed the data entry system for entering sample data records and recovery data records. This system is implemented in FORTRAN. Entry of the sample and recovery data records is performed under contract. The contractor enters the data directly onto the PBS VAX computer using this software system. Output files from this system are used as input to the on-line database developed by M. Hamer.

B. Kuhn designed, developed, and implemented a general purpose reporting and access software system for the database. This system is the route most users use to access the database. See Kuhn (1988) for more information.

Presently, the management of the database is performed by the Salmon Information Systems group (i.e. entering new codes into tables, building in current years data). Entering release records (including American releases) is undertaken by N. Williscroft of the Salmon Services[9] group. N. Williscroft ensures the release data are entered quickly and resolves problems related to these data. The user access and reporting software is maintained by B. Kuhn. M. Hamer maintains the entry level database access software. The contractor continues to enter the recovery and sample data.

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[9]Salmon Services, Fisheries Branch, 555 W. Hastings, Vancouver B.C.

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Since the development of the MRP database and this document was a real team effort, the personnel involved are listed alphabetically in the table below.

Name	Branch	Current position/title
Bailey, D.	Resource Enhancement	Assessment Biologist
Birch, M.	Fisheries Operations	Manager: Salmon Services Unit
Collicutt, L.	Fisheries Operations	Sport Fishing Data Manager
Cross, C.	Resource Enhancement	Assessment Biologist
Hamer, M.	Biological Sciences	Analyst/Programmer
Holmes, M.	Biological Sciences	Salmon Statistics Info. Officer
Hoyt, T.	Fisheries Branch	--- resigned ---
Hudson, G.	Biological Sciences	Salmon Statistics Info. Officer
Kuhn, B.R.	Biological Sciences	Stock Information Specialist
Lapi, L.	Biological Sciences	Salmon Information Systems Head
Lehmann, S.	Resource Enhancement	E.P.I.C. Coordinator
Mulligan, T.J.	Biological Sciences	Research Scientist
Palermo, V.	Fisheries Branch	Salmon Services Biologist
Riddell, B.	Biological Sciences	Salmon Production Section Head
Schnute, J.	Biological Sciences	Research Scientist
Whitehead, V.	I.T.S.D.	Analyst/Programmer
Williscroft, N.	Fisheries Branch	Mark Recovery Technician